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ABSTRACT

This booklet begins by examining the role played by evaluation in course and curriculum development, and then shows how the basic "error elimination" approach advocated by the philosopher Karl Popper can be used as a basis for the on-going evaluation of instructional systems. Next, two contrasting paradigms of evaluation are described, one that concentrates on measuring the outcomes of the instructional system (the agricultural/botanical or scientific approach) and one that pays more attention to what happens during the educational process itself (the social/anthropological or illuminative approach). Finally, five diagnostic techniques commonly used as part of an evaluation strategy are reviewed and the respective uses, strengths, and weaknesses of each are discussed: (1) results from student assessment; (2) student questionnaires and interviews; (3) observation of the instructional system in progress; (4) feedback from teaching staff directly involved with the instructional system; and (5) feedback from people having an indirect link with the instructional system. Models of the systems approach to course development, the role of an instructional system, and the general methodological approach advocated by Popper are provided, as well as extracts from a Likert scale and a semantic differential scale taken from course evaluation questionnaires. An annotated list of three items recommended for further reading is included. (MES)

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The Role of Evaluation in Course and Curriculum Development

Introduction

This booklet deals with the subject of *evaluation*. It begins by examining the role played by evaluation in course and curriculum development, and then shows how the basic 'error elimination' approach advocated by the philosopher Karl Popper can be used as a basis for the on-going evaluation of instructional systems. Next, the booklet describes two contrasting paradigms of evaluation – one that concentrates on measuring the *outcomes* of the instructional system (the so-called *agricultural/botanical* or *scientific* approach), and one that pays more attention to what happens *during* the educational process itself (the so called *social/anthropological* or *illuminative* approach). Finally, it reviews the range of diagnostic techniques which are commonly used as part of an evaluation strategy and discusses the respective uses, strengths and weaknesses of each technique.

The role of evaluation in instructional design

In the booklet on 'Education objectives', it was shown that the process of course or curriculum development can be represented schematically by figure 1.

As can be seen, the process is basically cyclic in nature, with the first three stages being:

(i) the formulation of a clear set of *objectives* for the course or curriculum;

(ii) the selection of appropriate *instructional methods* for achieving these objectives within the context of the course or curriculum;

(iii) the *implementation* of the course or curriculum.

In the booklet on 'Student assessment', we started to examine the fourth and final stage of the process – the *assessment and evaluation* stage. In that booklet, we distinguished between *assessment* and *evaluation*, showing that the two terms (which are often used virtually synonymously in common parlance) have radically different meanings when used in an instructional context.

We defined *assessment* as 'those activities that are designed to measure *student learning* achieved as a result of a teaching/learning

situation', and *evaluation* as a 'series of activities that are designed to measure the *effectiveness of a teaching/learning system as a whole*'. However, we noted that the results of student assessment may well form part of the wider evaluation process.

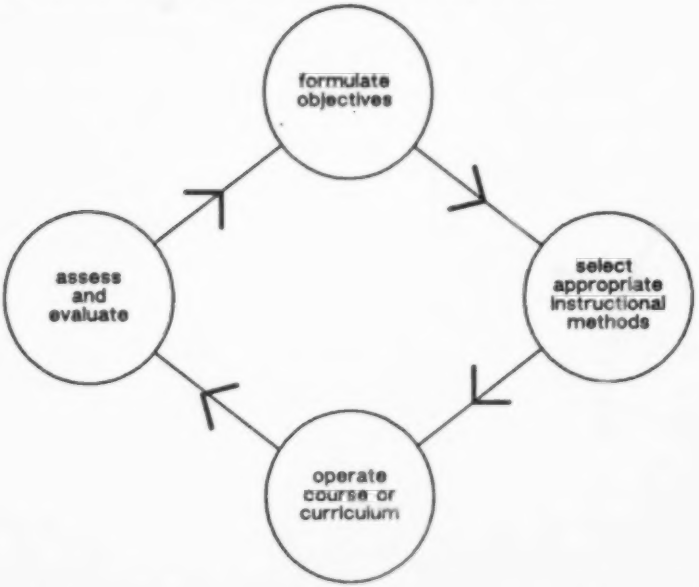

Figure 1: schematic representation of the systems approach to course or curriculum development

Within the systematic approach to instructional design that is shown in figure 1, the role of on-going monitoring and evaluation of the system is of vital importance to its development and evolution. Because of the cyclical and interactive nature of the system, each cycle can benefit from the experiences and feedback obtained from previous cycles. Evaluative feedback can be gained from a wide range of sources and via a wide range of methods, and, in many cases, a whole battery of evaluation techniques are used in order to gain an overall view of the effectiveness of the system in question. Whether this is a complete course, part of a course, a particular teaching session, a self-instructional programme, or a teaching aid such as a film or video, the designer (or team of designers) should never be happy with their first attempt, or even with revised versions. If one takes the view that 'the system can always be improved', on-going evaluation should *always* be an integral part of the design process.

The scope and depth of the evaluation that is carried out in any particular case will vary according to the nature of the situation, as, indeed, will the evaluation methods used. Whatever the circumstances, however, the importance of using appropriate evaluation procedures to monitor the instructional system and provide the basis for improvements cannot be underestimated. Feedback obtained from such evaluation should shed light on the appropriateness of the *teaching methods* used, the *structure* adopted, the *implementation strategy*,the *student assessment methods*, and even the *aims and objectives* themselves. With each successive cycle of the system, the teaching/learning situation should become progressively more finely 'tuned' and should consequently become *more efficient* and *more effective* through a continuous process of evolution and improvement.

Instructional development by error elimination – a 'Popperian' approach

The philosopher Karl Popper originally used the concept of 'error elimination' to explain how progress is made in developing scientific theories. The same concept can be applied to the development and improvement of instructional systems of all kinds.

Underlying rationale

The 'error elimination' approach to the development of instructional systems is based on two assumptions:

(a) that an instructional system is not an independent entity, justifying its existence *a priori*, but is part of a total system – fulfilling a specific function by helping to get from *Situation 'A'* shown in figure 2 to *Situation 'B'*.

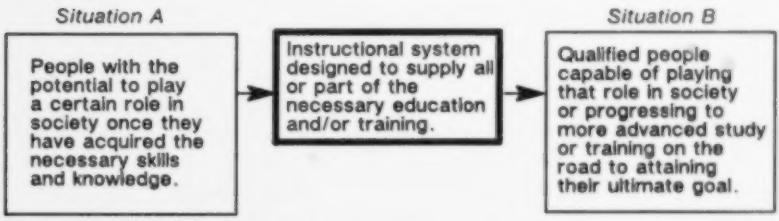
Situation A
People with the potential to play a certain role in society once they have acquired the necessary skills and knowledge.
Instructional system designed to supply all or part of the necessary education and/or training.
Situation B
Qualified people capable of playing that role in society or progressing to more advanced study or training on the road to attaining their ultimate goal.

Figure 2: the role of an instructional system

(b) that the development and improvement of the instructional system is most effectively tackled by adopting the general

methodological approach proposed by Karl Popper, an approach that can be summarised by the schema shown in figure 3.

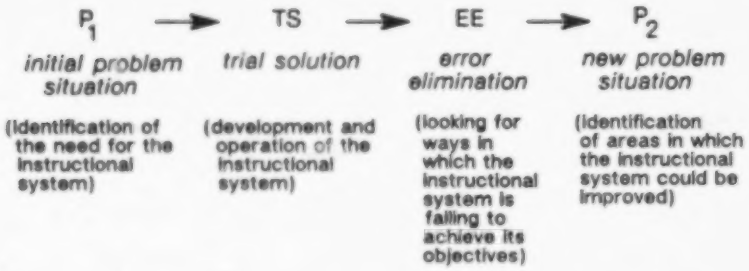
P1
TS
EE
P2
initial problem situation
trial solution
error elimination
new problem situation
(identification of the need for the instructional system)
(development and operation of the instructional system)
(looking for ways in which the instructional system is failing to achieve its objectives)
(identification of areas in which the instructional system could be improved)

Figure 3: the general methodological approach advocated by Karl Popper

Stages in the development of an instructional system

We see that there are four general stages in the above approach.

Stage 1: The identification of the initial 'problem situation' (P_1).

This itself can be seen as having three sequential stages:

(a) Identification of the desired objectives (knowledge, skills and attitudes); let us call these 'X'.

(b) Identification of the relevant knowledge, skills and attitudes already possessed by the prospective students; let us call these 'Y'.

(c) Identification of the objectives represented by 'X–Y', the gap to be bridged by the instructional system.

Stage 2: Development and operation of the instructional system (TS)

This falls into two stages:

(a) Designing an instructional system capable of achieving the objectives represented by 'X–Y' (or at least a part of the difference). This involves developing the overall structure, selecting and sequencing the content, choosing appropriate teaching methods, and so on.

(b) Making appropriate administrative arrangements to put the instructional system into operation (i.e. implementation of the system).

Stage 3: The 'error elimination' process (EE)

This stage involves carrying out a critical examination and analysis of Stages 1 and 2. It is the key stage in Popper's methodology, according to which a new instructional system can be regarded in the same way as a new scientific theory which has been developed in an attempt to resolve a specific problem situation but which has not yet been subjected to rigorous experimental testing. According to Popper, such a theory should be tested not by trying to prove it *right* (an impossible task from a logical point of view) but by trying to prove it *wrong*, i.e. by looking for specific ways in which the theory can be shown to be incompatible with experimental evidence. In the case of a new instructional system, the testing should be carried out not by trying to prove that is is succeeding in achieving its objectives (a very difficult thing to do with any degree of rigour) but by looking for ways in which it is manifestly *not* succeeding (a much easier task). Needless to say, such an approach requires a healthy attitude towards criticism that is sometimes lacking in those who develop and operate educational and training courses; all too often, these try to defend their course against criticism by contrived arguments and rationalization rather than accepting valid criticism and attempting to rectify the situation through improvements to the instructional system.

Stage 4: Identification of the new 'problem situation' (P_2)

If carried out correctly, Stage 3 should reveal areas in which the instructional system needs to be improved, and (hopefully) point to how these improvements might be carried out. It therefore leads to a new problem situation, P_2 , that can form the starting point of a further development cycle.

$$P_2 \longrightarrow TS \longrightarrow EE \longrightarrow P_3$$

Thus, Popper's methodology is seen to be both open-ended and on-going, forming a basis for the continuous development of instructional systems of all types.

How the error elimination process may be carried out

There are two basic questions that should be asked of an instructional system:

(a) Are there any ways in which the instructional system is manifestly failing to achieve its design objectives?

(b) Are there any ways in which the organisation and logistics of the instructional system are unsatisfactory?

Finding answers to question (a) is essentially a long-term process and can be done:

(i) by surveying students who have undergone the instructional system (i.e. former students), and

(ii) by surveying people who are not directly involved in the instructional system under scrutiny, but who nevertheless may be able to make relevant comments and observations (e.g. employers who subsequently take on the students, or the teachers and organizers of any subsequent courses or training situations to which the students proceed).

Finding answers to question (b) is usually easier, and can be done:

(i) by surveying the staff who are involved in implementing the instructional system, and

(ii) by surveying the students who are involved in the system.

Techniques through which the above information can be obtained will be discussed later in this booklet.

Two contrasting paradigms of evaluation

A major area of debate in educational evaluation is concerned with the relative merits of two distinctly contrasting approaches. On the one side, there is the so-called *agricultural/botanical* approach, which reflects a *'scientific'* approach to evaluation; on the other, there is the *social/anthropological* approach, which is more concerned with the hidden *processes* which occur during an educational experience. The latter approach has become known as *'illuminative evaluation'*.

The agricultural/botanical approach to evaluation

The *agricultural/botanical approach* has its origins in scientific experiments set up to assess the effects of specific variables (the nature of the soil, fertilisers, etc.) on the growth of crops. Such experiments have tight controls, and the resulting outcomes can generally be measured relatively easily. When applied to education, this approach has led to the use of systematic, objectives-oriented evaluation procedures. This 'traditional' strategy sets out to measure the extent to which a given instructional system has achieved certain specific goals (its *objectives*) in relation to the students' pre-knowledge or existing skills. To this extent, the agricultural/botanical evaluation paradigm measures *output* against *input*, and often treats the differences statistically. Other factors in the system, such

as the learning environment, teaching personnel, course content and structure, and teaching methods normally receive only incidental examination, if they are considered at all. This general 'systems approach' has been used when measuring the relative efficiency of different methods in teaching towards a common end, and also to measure the effectiveness of self-instructional programmes in achieving stated objectives.

The social/anthropological approach to evaluation

By comparison, the *social/anthropological approach* is more concerned with studying the on-going process of education. In general, the techniques used are far more subjective, and often involve personal value judgements of the results. The arguments in favour of this type of approach are that the variables in educational developments cannot be readily identified or controlled, and that 'inputs' and 'outputs' can be varied, complex, difficult to specify with certainty, and often virtually impossible to measure. In such cases, the evaluator explores the perceptions, opinions and attitudes of staff and students, using a variety of methods, in an attempt to reveal what was otherwise hidden in the educational process. The evaluation process is generally not rigidly structured or constrained, and usually gives the evaluator scope to follow up specific areas of interest as and when they become apparent. Illuminative evaluation of this kind has often been referred to as 'attempting to open up the black box of the educational process'.

Comparison of the two approaches

These two basic paradigms of evaluation differ significantly both in their methodologies and in their treatment of results. They also differ in their focus. The agricultural/botanical approach is basically designed to find out if *specified goals* have been achieved. The social/anthropological approach, on the other hand, is more flexible, and is designed to find out *what* has been achieved and *why*.

Clearly, there must be some middle ground between what, on the one hand, purports to be a purely objective approach, and the largely subjective approach that is embodied in illuminative evaluation. Where the correct balance lies, however, depends to a large extent on what is being evaluated, and for what purpose. A useful review of how appropriate evaluation strategies can be matched with different types of educational development has been given by Tony Becher (see review article cited in 'Further Reading' section at end of booklet), and interested readers are referred to this.

A review of evaluation techniques

As should be evident from the previous section, there is no *single* correct way to conduct an evaluation exercise. One may, for example, be looking for outcomes (whether intended or not) in cognitive, affective and skills areas, and also for an insight into possible problems concerning the implementation and operation of an instructional system. Much also depends on whether one is adopting an 'illuminative' strategy or a more rigid 'objectives-based' approach.

Because of the variety of information that one may be seeking during an evaluation, it is normally advisable to use an appropriate *battery* of evaluation techniques. Some of the possible information sources are listed below:

(a) results from student assessment;

(b) student questionnaires and interviews;

(c) observation of the instructional system in progress;

(d) feedback from teaching staff directly involved with the instructional system;

(e) feedback from people having an indirect link with the instructional system.

Each of these sources of feedback generally has an important part to play, regardless of whether the evaluation is of a course or unit of teaching that is still in the process of development (*formative evaluation*) or of a fully-developed instructional system that is already in use (*summative evaluation*). Let us now examine each source in more detail.

(a) Results from student assessment

When an instructional system has sharply-defined objectives, a critical study of the results obtained from student assessment can be of great assistance in the error elimination process described above. Two basic techniques can be used.

(i) *Analysis of student assessments that form a normal part of the instructional system*

When student assessments are an integral part of a course or other instructional system, the results of and trends indicated by these assessments can usually shed considerable light on the operation of the system as a whole. The evaluator should, as a result, be able to judge which objectives are being well achieved, and, more importantly, which objectives are *not*.

When students do not perform as well as expected, there is a traditional tendency to conclude that it is basically the fault of the students. This may occasionally be the case, but, more often than not, there are other factors involved. A systematic approach to instructional design allows *all* aspects of the system to be analysed, and may reveal that there are in fact a number of reasons for unsatisfactory student achievement, e.g.:

- the teaching methods were not well matched to the course objectives;
- there were problems in the operation of the instructional system;
- the assessment methods used were not suitable;
- the objectives themselves were not realistic.

Critical analysis of this sort allows the instructional system to be continuously monitored and progressively 'tuned'.

(ii) *Analysis of student assessments carried out solely for evaluation purposes*

When an instructional package of some sort is being trial tested, or when the relative effectiveness of two methods is being measured, specially-designed student assessment techniques can be used to evaluate the effectiveness of the *methods* involved, rather than to assess the *students* themselves. Such approaches are normally essentially 'agricultural/botanical' in nature, and often involve the use of pre- and post-tests, 'control' groups, and the statistical analysis of differences. They are one of the standard methods of evaluating new systems, techniques, packages, etc.

(b) Student questionnaires and interviews

Obtaining feedback from students regarding their experiences with and their opinions of an instructional system is one of the most common approaches to evaluation. The information can be sought through *questionnaires* and/or *interviews*, and can be treated either objectively or in a more illuminative manner. Student feedback can be obtained through a variety of so-called 'self-reporting' techniques, several of which have been adopted from the field of attitude measurement. Let us now examine some of the more important of these techniques.

Likert scales

Essentially, a *Likert scale* is an attitude measurement instrument consisting of a list of statements, the person responding having to

make a judgement on each statement, often selecting one response from a number of degrees of agreement and disagreement. A typical example is shown in figure 4.

	Strongly agree	Agree	Disagree	Strongly disagree
1. I find the course easy				
2. The course contains too many lectures				
3. The course does not include enough practical work				
4. The course provides satisfactory facilities for individual tutorials				
5.				

Figure 4: part of a Likert scale used in a course evaluation questionnaire

The number of points on such a scale depends on the specific requirements of the setter, although the use of an even number of options has the advantage of making it impossible for students to 'duck the issues' by repeatedly taking refuge in a completely neutral category.

In practice, it is harder to produce 'good' statements than it first appears, and some trial testing of the statements may well be necessary. Indeed, there is a fair amount of skill associated with preparing statements which are *valid* (see booklet on 'Student assessment'), and which, at the same time, provide good discrimination.

Likert scales can be used to monitor students' general opinions of an instructional system. It is also possible to use such statements for comparative purposes, e.g. by pre- and post-testing the students, or by comparing an 'experimental' group with a matched 'control' group.

Semantic differential scales

A *semantic differential scale* is a somewhat different type of attitude scale, consisting of word pairs of antonyms joined by a 3, 4, 5, 6 or 7 point scale. The method is based upon the premiss that the word pairs are opposites, although this may not always be valid in practice, because of the fact that particular words sometimes have different meanings for different students. Part of a typical semantic differential scale of the type used in course evaluation is shown in figure 5.

I consider the course to be: (mark appropriate box on each row of scale)

easy							difficult
inflexible							flexible
too theoretical							too applied
poorly structured							well structured

Figure 5: part of a semantic differential scale used in a course evaluation questionnaire.

Objectives rating

Student ratings of the degree of achievement of learning objectives is sometimes used in student feedback questionnaires. Here, the objectives of an instructional system are listed, and the student is asked to indicate whether each objective has been 'well achieved' through to 'not achieved at all'. The rating is generally carried out using a five-point scale, but variations are possible. This type of scale is particularly useful in cases where no other suitable technique exists for measuring the achievement of certain objectives, or as a cross-check on other evaluation techniques.

Free student comments

If students are allowed to respond freely on topics raised in a questionnaire, unexpected outcomes and attitudes may often emerge. Although it may be difficult to categorise free responses, these should normally be sought as a matter of principle, since they can often add a completely new dimension to an evaluation.

Interviews with students

Student interviews are basically a verbal form of student questionnaire. A well-run interview can, however, probe more deeply and sensitively into specific areas of interest than can normally be done in a written questionnaire. One drawback is that individual interviewing is a time-consuming procedure. Thus, the most effective role of sampled interviews may well be to check the validity of a more widely-used formal questionnaire.

(c) Observation of the instructional systems in progress

An understanding of the hidden educational processes occurring within an instructional system may sometimes be developed by means of careful and sensitive observation of these processes. The observation can be direct and immediate, or may be recorded in some way (e.g. on videotape) for later analysis. Such techniques are particularly useful when one is evaluating exercises designed to develop communication and interpersonal skills. The ethical problems associated with 'unobstrusive assessment' that were mentioned in the booklet on 'Student assessment' are not really a problem in this case, as it is the *instructional system* which is under scrutiny, not the students.

(d) Feedback from teaching staff directly involved with the instructional system

Through questionnaires, interviews and solicited comments, the opinions of staff directly involved in the implementation and operation of an instructional system can be of great value in course evaluation. Their comments may be influential in evaluating all aspects of the system, including the validity of the objectives, the course structure, the teaching sequence, the assessment methods, and the day-to-day organisation and management.

(e) Feedback from people having an indirect link with the instructional system

People who do not have a direct link with the actual teaching/learning system under investigation may still be able to make an important contribution to its evaluation. Again, questionnaires, interviews and solicited comments are appropriate means of gathering information.

The advice of *employers*, for example, may be sought if a vocational course is being evaluated. This may be done at the *formative evaluation* stage, before a course has been fully developed (in order to assess the skills and qualities which employers are looking for from students). It may also be done as part of a *summative evaluation* process (to gather information on the relevance of the

course to the actual work situation and on the general strengths and weaknesses of former students).

Similarly, the comments of *former students* can be important, since they are in a position to comment on the relevance of the course or other instructional system in retrospect, and perhaps suggest improvements with the benefit of hindsight and experience.

If a course has *external examiners*, their comments are invariably *extremely* influential in course development. Such feedback will probably prove even more valuable if the external examiners concerned are given some guidance as to which particular aspects should be commented upon, however.

Finally, the opinions of *teachers* who subsequently take on a particular group of students for a related course are often highly relevant. Their comments on the students' strengths and weaknesses may be important when revising a particular instructional system, or part thereof.

Conclusion

Evaluation is a valuable, and, indeed, *essential* component of the process by which the on-going development of instructional systems occurs. The evaluator has a wide range of techniques at his disposal, and also has several relevant sources of feedback which may assist in compiling a 'total picture' of the system and its effects (both good and bad). No single approach is the best in all circumstances, and it is generally most profitable to use a battery of appropriate evaluation techniques to ensure that the overall evaluation process is as valid and useful as possible.

Further Reading

1. *Evaluation and educational technology*, by T. Becher. In *Aspects of Educational Technology XV*, edited by F. Percival and H. I. Ellington; Kogan Page, London; 1981. (An extremely useful review of the general field of evaluation.)
2. *Measuring and Evaluation in Teaching*, by N. E. Gronlund; Macmillan, New York; 1971 (one of the definitive texts on the subject.)
3. *The Evaluation of Instruction*, by N. C. Wittrock and D. E. Wiley; Holt, New York; 1970 (Another definitive text on the subject.)